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# THE IRIS THRIPS AND ITS CONTROL BY HOT WATER, WITH NOTES ON OTHER TREATMENTS

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## INTRODUCTION

A new species of wingless thrips was described by J. R. Watson in 1924 as *Bregmatothrips iridis*, from specimens collected in 1923 at the port of entry on iris from France and the Netherlands.[2] Since that time this insect has been repeatedly intercepted on iris from these countries and from England. It was not known to occur on established plantings of iris in the United States until its discovery in October 1931 on Japanese iris at Hamburg, N. Y.[3] The thrips has subsequently been found in iris plantings in many localities in and near New York City, and has also been collected in one or more places in New Hampshire, Massachusetts, New Jersey, Pennsylvania, Maryland, Virginia, Ohio, Washington,[4] and Oregon.[4] Correspondence, not confirmed by identification of the insects, however, indicates that it was also present during 1934 in Montreal, Canada.

Although all these records are based on collections made within the last 5 years, it is believed that this thrips was present in Brooklyn, N. Y., as long ago as 1929, as typical thrips injury was observed on plants that year. The infestation at Hamburg, N. Y., may date

[1] This circular is a joint contribution by representatives of the organizations indicated, and is designated as Brooklyn Botanic Garden Contribution No. 79. The authors are greatly indebted to George M. Reed, curator, Brooklyn Botanic Garden, for his cooperation and helpful criticism during the progress of the investigations. Grateful acknowledgment is also due to the New York State Institute of Applied Agriculture, Farmingdale, N. Y., for the use of their land and facilities in the isolation and propagation of treated plants.

[2] Watson, J. R. A new Bregmatothrips (Thysanoptera) from England and Holland. Ent. Monthly Mag. 60: 253-254. 1924.

[3] Smith, F. F. The occurrence of Bregmatothrips iridis Watson in the United States. (Sci. note.) Jour. Econ. Ent. 26: 916. 1933.

[4] Record supplied by C. F. Doucette, Sumner, Wash.

from 1927, and infestations in the States of Washington,[4] New Jersey, and Maryland may be considerably older.

## ECONOMIC IMPORTANCE AND INJURY

This thrips has been found only on iris except for one collection from poker plant (*Kniphofia uvaria* Hook.). Certain types of iris are severely injured whereas others show little or no injury. The resistant types, however, may harbor the thrips in varying numbers and may serve as sources of infestation if moved among more susceptible ones.

The thrips feed on the inner surface of leaf sheaths and on young leaves from May until November and, depending on the variety or species, cause a russeting or sootlike blackening of foliage (fig. 1) and apparently a varying amount of stunting of growth (table 1). Observations have been made over a period of 3 years on infested Japanese iris plants that were very much dwarfed and produced few flowers, but which, after treatment to remove the thrips and transplanting to a new location, became vigorous. While it seems logical to conclude that the extensive foliage injury does dwarf the plants, it is believed that further experiments are needed to differentiate between the effect of insect injury and the variation in soil conditions or such other factors as the frequency of division and transplanting, and the growth responses of clumps. In the case of *Iris setosa* Pallas, however, there appears to be little doubt about the marked stunting effect that follows bad russeting of foliage by thrips.

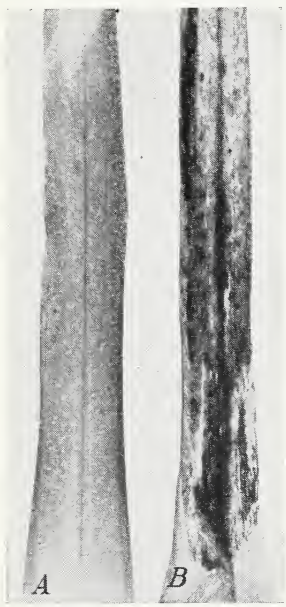


FIGURE 1.—Areas in leaf sheath of *Iris pseudacorus* (*B*) injured by the iris thrips compared with uninjured sheath (*A*).

Iris plants growing with their bases submerged in the water of a pool or brook during the summer have been observed to be as severely injured as are some of those growing in the field or garden.

The degree of foliage injury varies not only among the various groups of the genus (table 1) but also among varieties of a given species. Some varieties of Japanese iris are severely injured whereas adjacent plants of another variety carry a low population and show very little injury. Also, in some plantings where thrips are present one variety will show severe injury in one instance and in another will be relatively clean.

The great variation in the degree of injury on adjacent plants in the early part of the season appears, in some cases at least, to be correlated with the number of thrips successfully overwintering on each clump. After flowering of the plants and also migration of the thrips, the infestation and injury tend to become more uniform in a bed of Japanese iris.

As indicated in table 1, the flower injury is at present recognized only on both the wild and cultivated forms of *Iris ensata* Thun.

[4] Record supplied by C. F. Doucette, Sumner, Wash.

(formerly *I. kaempferi* Siebold)[5] and particularly on the late-flowering varieties. The species and varieties of iris that bloom early in the season and also many of the earlier varieties of Japanese iris apparently escape injury.

TABLE 1.—*Summary of observations on injury by Bregmatothrips iridis on various types of iris, 1934–36, Brooklyn, N. Y.*

| Host [1] | Foliage injury | | Degree of stunting | Flower bract injury |
|---|---|---|---|---|
| | Type | Degree | | |
| Bearded iris: | | | | |
| Tall bearded iris | Black | Slight to moderate. | None | None. |
| Dwarf bearded iris | do | do | do | Do. |
| Crested iris (*I. tectorum*) | do | Slight | do | Do. |
| Beardless iris: | | | | |
| *I. fulva* | do | do | do | Do. |
| *I. foliosa* | do | do | do | Do. |
| *I. fulva-foliosa* hybrids | do | do | do | Do. |
| *I. ensata* | Rusty | do | Slight | Slight. |
| *I. ensata* hybrids (Japanese iris) | do | Slight to severe | Slight to severe | None to severe. |
| *I. setosa* | do | do | do | None. |
| *I. laevigata* | do | Slight | Slight | Do. |
| *I. orientalis* | None | None | None | Do. |
| *I. sibirica* | do | do | do | Do. |
| *I. orientalis-sibirica* hybrids | do | do | do | Do. |
| *I. wilsoni* | do | do | do | Do. |
| *I. aurea* | Black | Slight | do | Do. |
| *I. ochroleuca* | do | do | do | Do. |
| *I. graminea* | None | None | do | Do. |
| *I. virginica* | Rusty | Slight | Slight | Do. |
| *I. versicolor* | do | do | do | Do. |
| *I. versicolor-laevigata* hybrid | do | Moderate | do | Do. |
| *I. virginica-laevigata* hybrid | do | do | do | Do. |
| *I. pseudacorus* | Black | Severe | None to moderate | Do. |
| *I. dichotoma* | Rusty | do | Slight | Do. |

[1] A species of bulbous iris, *I. zyphium*, was also noted as a host, the thrips being found on the bulbs, but observations as to injury are lacking.

As the flower spikes elongate, the thrips feed within the sheaths of the stem leaves on the stem and later beneath the bracts enclosing the flower bud. In many instances the inner side of the bract is completely fed over and russeted (fig. 2) while the enclosed rolled petals are untouched and the flower expands normally. In some cases the thrips feed on the petals in the bud stage, giving them a flecked appearance on opening; in others they feed on the margins of the petals so that the flowers expand imperfectly and are called "bloated" (fig. 3). The iris thrips does occasionally feed on the flower petals, as evidenced by pigmented contents of the alimentary tracts of larvae, but it is believed that much of the observed injury to iris flowers has been due to feeding by the gladiolus thrips (*Taeniothrips simplex* Mor.). In contrast to the habits of *T. simplex*, which appears to favor flower parts as food, the iris thrips apparently feeds rather infrequently on the tender rolled petals within the bracts and in most cases leaves the flowering part after having fed over all the available inner surfaces of the bracts.

## SEASONAL HISTORY

These thrips pass the winter as adult females in contact with the living tissue of young leaf buds, where they are protected by the bases of old foliage still attached to the crown. They appear sluggish

[5] REED, G. M. THE IRIS OF JAPAN. Amer. Iris Soc. Bull. 40., 48 pp. 1931. See pp. 36–38.

when examined during the winter at near freezing temperatures, but are observed to be active when the temperature is 50° F. or higher. If taken to a warm place they become active within an hour, feed, and in a few days begin to lay eggs beneath the epidermis of leaf tissue.

Near New York, N. Y., oviposition usually begins late in April, and the first offspring become adults late in May. Evidently there is an overlapping of generations, since the insect is present in all stages during the remainder of the season until sometime in October, when oviposition ceases and the last larvae develop to adults.

FIGURE 2.—Bud of Japanese iris showing rusty areas on bract and stem leaves following injury by the iris thrips.

The insects are apparently least abundant in April before oviposition begins. The population increases rapidly on the succulent foliage and becomes most abundant late in June, about flowering time. During July and August the insects decrease in numbers, possibly owing in part to a less favorable condition of the foliage but also to the activity of the bug *Orius insidiosus* Say, which preys on larvae, pupae, and adults. A hundred or more thrips in the various stages have often been found within the leaf sheaths of a single shoot of iris during June, whereas late in October not more than 16 adults have been observed on shoots of the same plant.

## MACROPTEROUS FORMS

The original collections from which this thrips was described contained only wingless females (fig. 4). The first males to be recognized were reared from overwintering females in 1932.[6] These were also wingless. The first winged female was collected from bulbous iris in October 1932. In the course of observations on the thrips during the seasons 1934 to 1936, inclusive, careful search was made for the presence of winged thrips. These have been found with wingless adults among the first-generation offspring maturing late in May and have been most abundant during June. In 1936, 53 winged adults were collected from May to July; others were observed July 10 and October 1. It is evident from field observations

[6] SMITH, F. F. See footnote 3, p. 1.

that the winged adults produced in May and June are offspring of overwintering females. Only a small portion of the adults present at any one time are winged, and thus far all observed winged adults have been females.


FIGURE 3.—Flower of Japanese iris (*A*) showing "bloated" effect of iris thrips injury on petal margins in the bud stage, compared with an uninjured bud (*B*).

## DISSEMINATION

As pointed out by Watson,[6] the occurrence of winged adults adds to the probability of dispersal. Although the winged adults seem very sluggish, it appears that the greatest spread to nearby iris in the same garden takes place during June when winged forms are abundant. Wingless adults spread very slowly to adjacent plants early in the spring and fall as evidenced by examination of adjacent clean and infested plants.

## HABITS

The iris thrips is usually located between contiguous leaves or in the leaf sheaths, and when exposed the adults slowly crawl about until they find cover. One or two adults are often found feeding on the

[6] SMITH, F. F. See footnote 3, p. 1.

leaf surface, and at times the exposed adults are quite numerous. In the early part of the day larvae have been observed feeding in large numbers on the surface of foliage and flower buds.

The eggs are laid in plant tissue, and the milky white larvae and pupae are found with the glistening dark brown adults.

## ORIGINAL HOST AND HOME

Since *Bregmatothrips iridis* was first observed severely injuring Japanese iris, it might be assumed that this was the original host and, if so, that Japan might be the original home. The following circumstantial evidence, however, points to the probability that this is not the case:

FIGURE 4.—Adult female iris thrips (*Bregmatothrips iridis*), wingless form. × 93.

(1) George M. Reed, who visited many of the iris gardens in Japan in 1930 and procured stocks of practically all varieties that he was able to locate in that country, never observed the rusty foliage on iris in their native home. About that time, however, he did note this type of injury in the collection of iris under his supervision in Brooklyn, N. Y. In 1924 the same injury had been noted in a nursery in New Jersey.

(2) At the present time certain collections of Japanese iris in this country that have been grown separately from all other irises since their importation from Japan are still free of the iris thrips. This evidence is rather important, since these irises were handled in Japan by the same firm that in recent years has exported most of the iris from that country. It would seem that an infestation existing there would have been manifest in some of their exported stock on its inspection at entry into this country.

(3) Based on the interceptions made on imported stock from several European countries, the iris thrips is apparently quite generally distributed in England and on the Continent.

(4) If Europe is the original home of the iris thrips, a likely host is the yellow flag (*Iris pseudacorus* L.), which is widely distributed in Europe and has become naturalized in the United States. This plant is apparently a favored host, since larger numbers of thrips develop on it than have been observed on any other iris, and the strongly growing plant shows relatively little stunting. The sooty-black injured areas are not conspicuous, so that injury and the thrips causing it could be readily overlooked. In the present studies all plantings of *I. pseudacorus* have apparently been infested with thrips, in some cases even where other irises on the same property were clean.

## EFFECT OF CULTURAL PRACTICES ON THRIPS

Burning off of old foliage early in the spring before growth starts has not killed out the thrips on Japanese, tall bearded, or southern iris, even when a torch was used to insure a more complete burning of the debris. At that season the thrips are located too deeply in the crowns of the Japanese iris to be affected by any heat that would not at the same time injure the plants.

Japanese iris are often grown in beds covered with water during the preflowering period, and it was considered possible that the thrips could be killed by covering the entire foliage. A 24-hour immersion, however, was ineffective, and a longer period was considered likely to be injurious to the plants.

## CONTROL

Control experiments have been directed toward developing a method that can be used to eliminate the thrips from a given stock of plants. Such a method is particularly needed by commercial growers with infested plants, whether they desire to effect a complete clean-up of their entire stock or merely wish to insure against sending out any thrips with shipments. On the basis of the present studies some such method seems entirely practicable since the hosts of this thrips are limited and practically all adults of this sluggish insect are wingless at certain seasons of the year, which reduces the danger of dissemination and reinfestation.

Preliminary experiments have also been made on certain fumigants, insecticidal sprays, and dusts that might serve as a means of control on plants established in gardens and parks.

### HOT-WATER TREATMENT

All stages of the thrips can be eliminated by immersing the plants in hot water at the time of digging and dividing for sale or replanting (table 2). In preliminary tests conducted in April 1934, immersion periods of 15 to 20 minutes at 110° F. gave incomplete kills of adults in the leaf sheaths, but immersion for 15 minutes or longer at temperatures of 112° to 120° gave complete kills. At 110° a treatment of 30 minutes or longer killed all thrips present, and treatment at this lower temperature has been adopted as a standard control because of a minimum of injury or set-back to the plants. All treatments were made in a thermostatically controlled hot-water tank.[7] The beginning of treatment is reckoned from the time the water temperature has become stabilized after the plant material has been immersed. If the water temperature is unchanged on account of the small lot of material being treated, a preheating period of 5 minutes is allowed.

[7] SMITH, F. F. THE CYCLAMEN MITE AND THE BROAD MITE AND THEIR CONTROL. U. S. Dept. Agr. Circ. 301, 14 pp., illus. 1933. (See p. 10.)

TABLE 2.—*Control of Bregmatothrips iridis by immersion of infested plants in hot water, Brooklyn, N. Y., 1934–36*

| Temperature of water (degrees Fahrenheit) | Duration of treatment | Season of treatment | Host species treated[1] | Thrips in test | | | Killed all stages | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | | | Adults | Pupae | Larvae | | |
| | *Minutes* | | | *Number* | *Number* | *Number* | *Percent* | |
| | 15 | April | S | 52 | 0 | 0 | 40.4 | |
| | 20 | do | S | 34 | 0 | 0 | 94.1 | |
| | 20 | July | L | 96 | | 17 | 96.5 | Survivors were adults. Large clumps in test. |
| | 20 | do | L | 73 | | 24 | 100 | Divided rhizomes. |
| 110 | 25 | do | L | 168 | | 22 | 98.9 | Survivors were adults on large clumps. |
| | 30 | April, August, October. | S | 626 | 39 | 85 | 100 | |
| | 30 | July | L | 516 | | 79 | 100 | Large clumps. |
| | 45 | April | S | 183 | 0 | 0 | 100 | |
| | 60 | do | S | 19 | 0 | 0 | 100 | |
| 111[2] | 30 | October | S | 165 | 6 | 36 | 100 | Plants in this series treated in situ. |
| | 15 | April | S | 98 | 0 | 0 | 100 | |
| | 25 | do | S | 32 | 0 | 0 | 100 | |
| 112 | 30 | do | S | 26 | 0 | 0 | 100 | |
| | 45 | do | S | 35 | 0 | 0 | 100 | |
| | 60 | do | S | 29 | 0 | 0 | 100 | |
| 116 | 15 | do | S | 64 | 0 | 0 | 100 | |
| | 20 | do | S | 39 | 0 | 0 | 100 | |
| 118 | 15 | do | S | 38 | 0 | 0 | 100 | |
| 120 | 15 | do | S | 46 | 0 | 0 | 100 | |
| Untreated check | | do | S | 108 | 0 | 0 | | |
| | | July[3] | L | 189 | | 17 | | |
| | | October[3] | S | [4] 110 | 10 | [5] 29 | | |

[1] S=iris with small foliage as Japanese iris or southern iris. L=iris with large foliage; *Iris pseudacorus* and tall bearded iris.

[2] See text, p. 8.

[3] The checks were dug and handled as were the other plants, but without the immersion in the hot water.

[4] 3 adults dead.

[5] 29 larvae hatched from eggs in leaf tissue, none hatched from treated plants in tests in which all adults were killed.

In preparing the plants for treatment the clumps were dug, shaken free of soil, divided as for replanting, and the foliage was cut back to within a few inches of the rhizome. The stocks were then tied in muslin bags and immersed in the tank. After treatment they were drained of excess water and were then ready for replanting. During the treatment and the subsequent handling of the treated stock, precautions were taken to prevent reinfestation. In the practical application of the treatment 10,543 divisions from infested stock, including 5,858 of Japanese iris, 3,834 of bearded types of iris, and 851 of Siberian, southern, and miscellaneous species, were treated and planted in the isolated plots of the New York State Institute of Applied Agriculture at Farmingdale, N. Y. The efficiency of the treatment is demonstrated by the fact that no iris thrips have been found on any of these plants after repeated and careful examination during the one or two seasons following treatment.

### TREATMENT OF PLANTS IN SITU

In a series of tests (table 2) made in October 1934 the thrips were killed on large established clumps of iris by means of hot water without digging the plants. A metal cylinder was set over the plants with the edge sunk sufficiently into the soil to retain water (fig. 5). About 2

gallons of water at a temperature of 120° F. was poured into the cylinder to warm the surface layer of soil, then water at 114° was added until the foliage was covered. Radiation and the cooling effect of soil and foliage lowered the water temperature to 110°–111°, and this temperature was maintained for the duration of treatment by addition of water at 114°. This procedure may be used where a limited number of clumps in an ornamental planting are to be treated and it is undesirable to lift and divide them because of the set-back that would result from such disturbance.

### TOLERANCE OF HOST PLANTS

The tolerance to the hot-water treatments of the many species and varieties of iris, as determined by subsequent growth and flowering, has not been completely worked out, but it may be stated that the types of iris usually grown are satisfactorily treated at the season of the year during which they are ordinarily transplanted. When clumps of iris are divided and transplanted the new divisions flower irregularly or not at all during the succeeding flowering season. Usually the plants become fully reestablished during the season following the flowering period and will flower normally the second year. In comparative tests where divisions were transplanted with and without treatment, such iris as Japanese iris were uninjured by a treatment (fig. 6) extended much longer than is required to kill the thrips.

FIGURE 5.—Treating iris plants in hot water for the iris thrips without digging them.

The groups of bearded iris and the southern irises (*Iris fulva* Ker-Gawler, *I. foliosa* Mack. and Bush, and hybrids) are among those that are severely injured by spring treatment, but these can be treated satisfactorily during August, September, or October. The Japanese iris, in general, can be treated in either spring or fall, but plants treated in the spring, if given ordinary care, become the better established. In order to insure the successful reestablishment of Japanese iris following treatment and transplanting either late in the summer or in the fall, provision should be made to water the new plantings when necessary, since they are adversely affected by dry weather prevailing at that season. The detailed results of tests on the tolerance of the various types of cultivated iris are not included in this circular.

### INSECTICIDAL TESTS

Preliminary tests with 4 insecticidal sprays and a fumigant were made by the junior author during the preflowering season of 1936

on 20 plots of iris each containing 12 plants. The formulas of the four spray materials were:

No. 1. Derris powder (0.025 percent of rotenone in diluted spray); sulphonated castor oil (1 to 400).

No. 2. Lead arsenate ..... 3 ounces.
Brown sugar ..... 2 pounds.
Water ..... 3 gallons.

No. 3. Thiocyanate (containing 90 percent of active ingredients including lauryl thiocyanate) diluted 1 to 600 for use; spreader (containing sodium oleyl sulphate with a synthetic resinous sticker) diluted 1 to 1,000 for use.

No. 4. Manganese arsenate ..... 2 ounces.
Brown sugar ..... 2 pounds.
Water ..... 3 gallons.


FIGURE 6.—*a*, A clump of Japanese iris treated for the iris thrips for 60 minutes at 110° F. in March; *b*, an untreated clump of the same variety. Photographed as they appeared the following October.

All spray treatments were made six times at approximately weekly intervals beginning May 15 and ending June 16. Five fumigations were made by burning a tobacco powder containing 12.5 percent of nicotine beneath a paper-and-canvas hood at the rate of 2 ounces per 100 cubic feet of space and confining the fumes for 1 hour on the days that the regular sprays were applied to the other plants, but omitting the treatment on June 16.

The degree of foliage injury caused by the various materials, if evident 2 weeks after the treatment, and the population of thrips in each plot were compared at flowering time.

Certain of these materials were further tested in 1937. Tests with the derris-powder spray and with nicotine fumigation were made in 1937 during the preflowering period and again after the flowers had matured. On the basis of the 2 years' tests both the derris-powder spray and the fumigation with nicotine were very effective as controls. In both seasons the plants sprayed with derris had a much healthier appearance than did those in any plot treated with the other materials, not being injured by either thrips or insecticide. As might be expected, better control of the thrips was obtained on the younger, less dense foliage during May and June than on the very heavy foliage that develops after flowering.

In tests made with the other materials during the preflowering period, moderate control was obtained in both 1936 and 1937 with manganese arsenate and poor control in 1936 with both lead arsenate and lauryl thiocyanate.

During 1934 the following materials were found to be either ineffective as controls or injurious to the plants: Paris green (1 ounce) and brown sugar (2 pounds) in 3 gallons of water as used for the control of the gladiolus thrips caused severe injury to foliage of Japanese iris. Naphthalene flakes broadcast on the soil surface at the rate of 300 pounds per acre caused a varying degree of injury to foliage of plants in the greenhouse, whether the plants were covered or uncovered, and did not control the thrips. Fumigation with calcium cyanide at the dosage of 21 ounces per 1,000 cubic feet for 1 hour beneath paper-and-cardboard tents gave incomplete kills of thrips and caused slight injury when foliage was not completely dry. Like unsatisfactory results were obtained by a 6-hour fumigation with carbon disulphide at the dosage of 1,600 cubic centimeters per 1,000 cubic feet.

## SUMMARY

The iris thrips is primarily a pest of iris and is now known to be present in 10 States.

Foliage and leaf sheaths of many types of iris show a rusty or blackened injury, while on Japanese iris flower bracts and petals may be injured.

Insects of this species overwinter as adult females in the crown of the host. Oviposition begins late in April, and the first offspring reach maturity late in May. Development of generations continues until the latter part of October. Most adults are wingless, but macropterous females appeared with the first generation and were present during the summer and early part of the fall. Migration apparently occurs chiefly in June when winged forms are most abundant.

Available evidence indicates that Europe rather than Japan is the original home of the iris thrips.

Cultural practices such as burning off old foliage during winter or flooding the plants during the growing season did not control the thrips. The thrips may be killed on plants that have been lifted and freed of soil by immersing them for 30 minutes in water at 110° F.; or, on plants in beds, by flooding with water maintained at the desired temperature and confined in a cylinder pressed into the ground around the plant. Japanese irises are preferably treated in the spring, but are also satisfactorily treated late in the summer or in the fall provided

that newly set plants are regularly watered. Spring transplanting and treatment were disastrous to bearded irises, southern types of iris, and certain miscellaneous species, but treatments of these groups late in the summer or in the fall were successful.

In preliminary tests with insecticides and fumigants, a spray containing derris powder (0.025 percent of rotenone) and sulphonated castor oil (1 to 400) gave a high degree of control, as did also repeated 1-hour fumigations in which tobacco powder was burned beneath a paper tent.

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